

DATE: August 14, 1996 PPM-96-008  
TO: M. Sampson/311  
FROM: K. Sahu/300.1  
SUBJECT: Radiation Report on: CLR 79  
Project: GOES-K  
Control #: 15257  
Job #: EE61984  
Project part #: M39006/22-0631  
cc: A. Sharma/311  
OFA Library/300.1

A radiation evaluation was performed on CLR 79 (Tantalum Electrolytic Capacitor) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through IV and Figures 1 through 4.

The total dose testing was performed using a Co <sup>60</sup> gamma ray source. During the radiation testing, eight parts were irradiated unbiased and two parts were used as control samples. The total dose radiation levels were 100, 200, 300, 400, 500, 750, and 1000 krad<sup>\*</sup>. The dose rate was between 1.59 and 4.17 krad/hour (see Table II for radiation schedule). After each radiation exposure, parts were electrically tested according to the test conditions and the specification limits<sup>\*\*</sup> listed in Table III.

All parts passed initial electrical measurements.

All irradiated parts passed all electrical tests throughout all irradiation steps up to and including the 1000 krad irradiation level. Less than 1% change in capacitance was observed between the initial and final readings. An average increase of approximately 7% for dissipation factor and 20% for leakage current was seen between the initial and final readings.

Table IV provides the raw data and the mean and standard deviation values for each parameter before irradiation and after each irradiation exposure. Mean values of capacitance, dissipation factor and DC leakage are plotted with range bars in Figures 1, 2, 3 and 4, respectively.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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\* The term rads, as used in this document, means rads(SiO<sub>2</sub>). All radiation levels cited are cumulative.

\*\* These are manufacturer's pre-irradiation data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

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TABLE I. Part Information

Generic Part Number:	CLR 79*
GOES-K Part Number	M39006/22-0631
GOES-K Control Number:	15257
Charge Number:	EE61984
Manufacturer:	Sprague
Lot Date Code (LDC):	8813
Quantity Tested:	10
Serial Number of Control Sample:	1, 2
Serial Numbers of Radiation Samples:	3, 4, 5, 6, 7, 8, 9, 10
Part Function:	Tantalum Electrolytic Capacitor
Part Technology:	Nonsolid electrolyte
Package Style:	Cylindrical 2 leads
Test Equipment:	Bench test setup
Engineer:	T. Mondy

\* No radiation tolerance/hardness was guaranteed by the manufacturer for this part.

TABLE II. Radiation Schedule for CLR 79

EVENT-----	DATE
1) INITIAL ELECTRICAL MEASUREMENTS-----	06/10/96
2) 100 KRAD IRRADIATION (2.33 KRADS/HOUR)-----	06/11/96
POST-100 KRAD ELECTRICAL MEASUREMENT-----	06/13/96
3) 200 KRAD IRRADIATION (4.17 KRADS/HOUR)-----	06/13/96
POST-200 KRAD ELECTRICAL MEASUREMENT-----	06/14/96
4) 300 KRAD IRRADIATION (1.59 KRADS/HOUR)-----	06/14/96
POST-300 KRAD ELECTRICAL MEASUREMENT-----	06/17/96
5) 400 KRAD IRRADIATION (2.33 KRADS/HOUR)-----	06/17/96
POST-400 KRAD ELECTRICAL MEASUREMENT-----	06/19/96
6) 500 KRAD IRRADIATION (2.50 KRADS/HOUR)-----	06/19/96
POST-500 KRAD ELECTRICAL MEASUREMENT-----	06/21/96
7) 750 KRAD IRRADIATION (2.84 KRADS/HOUR)-----	06/21/96
POST-750 KRAD ELECTRICAL MEASUREMENT-----	06/24/96
8) 1000 KRAD IRRADIATION (2.94 KRADS/HOUR)-----	06/28/96
POST-1000 KRAD ELECTRICAL MEASUREMENT-----	07/08/96

Table III. Electrical Characteristics of CLR 79

Test Parameter, Units	Test conditions	Limits	
		Min	Max
Capacitance, $\mu\text{F}$	120 Hz, Bias = 10 VDC	19.8	24.2
Dissipation Factor, %	120 Hz, Bias = 10 VDC	-	7.5
Leakage Current, nA      25°C	Bias = 100 VDC	-	1000
Leakage Current, nA      125°C	Bias = 100 VDC	-	9000

**TABLE IV: Electrical Measurement Data and Statistical Analysis after Total Dose Testing of CLR 79 /1**

Spec. Lim./2			Total Dose Exposure (TDE) (krads)																							
Parameter	min	max	S/N	Initial @25°C		Initial @125°C		100		200		300		400		500		750		1000 @25°C		1000 @125°C				
Capacitance (µF)	19.8	24.2	3	23.30		24.10		23.40		23.30		23.40		23.40		23.40		23.40		23.40		24.10				
			4	23.30		23.90		23.30		23.30		23.30		23.30		23.30		23.30		23.40		23.99				
			5	23.50		24.10		23.40		23.40		23.40		23.40		23.40		23.40		23.50		24.16				
			6	23.50		24.20		23.50		23.50		23.50		23.50		23.50		23.50		23.50		23.60		24.21		
			7	23.50		24.20		23.50		23.50		23.50		23.50		23.50		23.50		23.50		23.60		24.24		
			8	23.50		24.10		23.40		23.40		23.40		23.40		23.40		23.40		23.40		23.50		24.11		
			9	23.40		24.10		23.40		23.40		23.40		23.40		23.40		23.40		23.40		23.50		24.16		
			10	23.20		23.90		23.20		23.20		23.10		23.10		23.10		23.20		23.20		23.20		23.96		
			mean		sd	mean		sd	mean		sd	mean		sd	mean		sd	mean		sd	mean		sd	mean		sd
			23.40		0.11	24.08		0.11	23.39		0.09	23.38		0.10	23.38		0.12	23.38		0.12	23.39		0.09	23.39		0.09

Spec. Lim./2					Total Dose Exposure (TDE) (krads)																		
Parameter	min	max	S/N	Initial @25°C		Initial @125°C		100		200		300		400		500		750		1000 @25°C		1000 @125°C	
Dissipation Factor (%)	-	7.5	3	2.60		1.80		2.70		2.60		2.70		2.70		2.70		2.80		2.70		2.20	
			4	3.00		1.90		3.00		3.10		3.00		3.00		3.10		3.20		3.10		2.39	
			5	2.50		1.80		2.40		2.50		2.60		2.50		2.60		2.50		2.60		2.28	
			6	2.30		2.10		3.10		3.00		3.20		3.20		3.20		3.20		3.20		2.40	
			7	3.10		1.80		2.70		2.70		2.70		2.70		2.80		2.80		2.80		2.36	
			8	2.70		2.00		3.30		3.30		3.30		3.30		3.40		3.40		3.40		2.41	
			9	3.20		2.00		3.20		3.30		3.40		3.30		3.40		3.30		3.30		2.36	
			10	2.60		1.80		2.60		2.60		2.60		2.70		2.70		2.60		2.60		2.34	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
				2.75	0.30	1.90	0.11	2.88	0.30	2.89	0.31	2.94	0.31	2.93	0.29	2.99	0.31	2.98	0.32	2.96	0.30	2.34	0.07

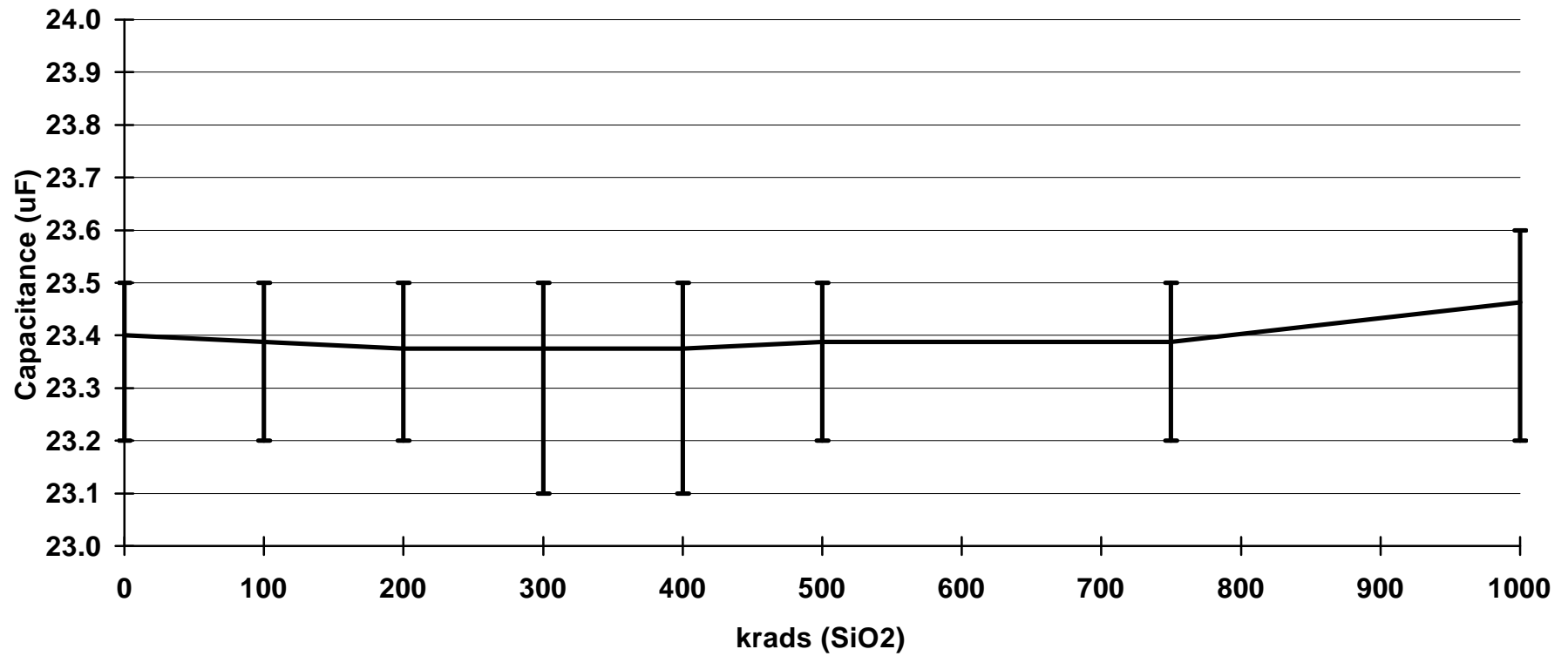
Spec. Lim./2					Total Dose Exposure (TDE) (krads)																								
Parameter	min	max	S/N	Initial @25°C		Initial @125°C		100		200		300		400		500		750		1000 @25°C		1000 @125°C							
DC Leakage (nA)	-	1000 /3	3	132.70		904.70		173.60		155.20		147.00		147.60		130.00		158.20		177.40		178.40		1141.01					
			4	147.28		916.70		180.80		155.60		147.30		139.80		143.70		157.40		178.40		178.40		1183.43					
			5	130.81		898.70		170.80		153.00		141.80		139.80		140.70		151.70		171.30		171.30		1001.38					
			6	147.54		917.90		180.90		164.80		144.40		144.20		141.90		164.00		169.70		169.70		1160.09					
			7	130.76		825.40		161.50		153.20		144.70		132.50		136.50		152.60		166.90		166.90		1106.72					
			8	124.07		899.40		167.60		156.30		144.70		141.80		146.10		162.70		177.70		177.70		1111.17					
			9	128.72		856.20		167.30		149.60		146.00		137.00		138.60		156.80		163.70		163.70		1059.97					
			10	141.97		826.60		168.90		149.20		143.30		132.00		126.90		148.60		168.20		168.20		1103.12					
				mean	sd		mean	sd		mean	sd		mean	sd		mean	sd		mean	sd		mean	sd		mean	sd			
				135.48	8.33		880.70	36.25		171.43	6.32		154.61	4.57		144.90	1.73		139.34	5.06		138.05	6.23		156.50	4.99		171.66	5.21

Notes:

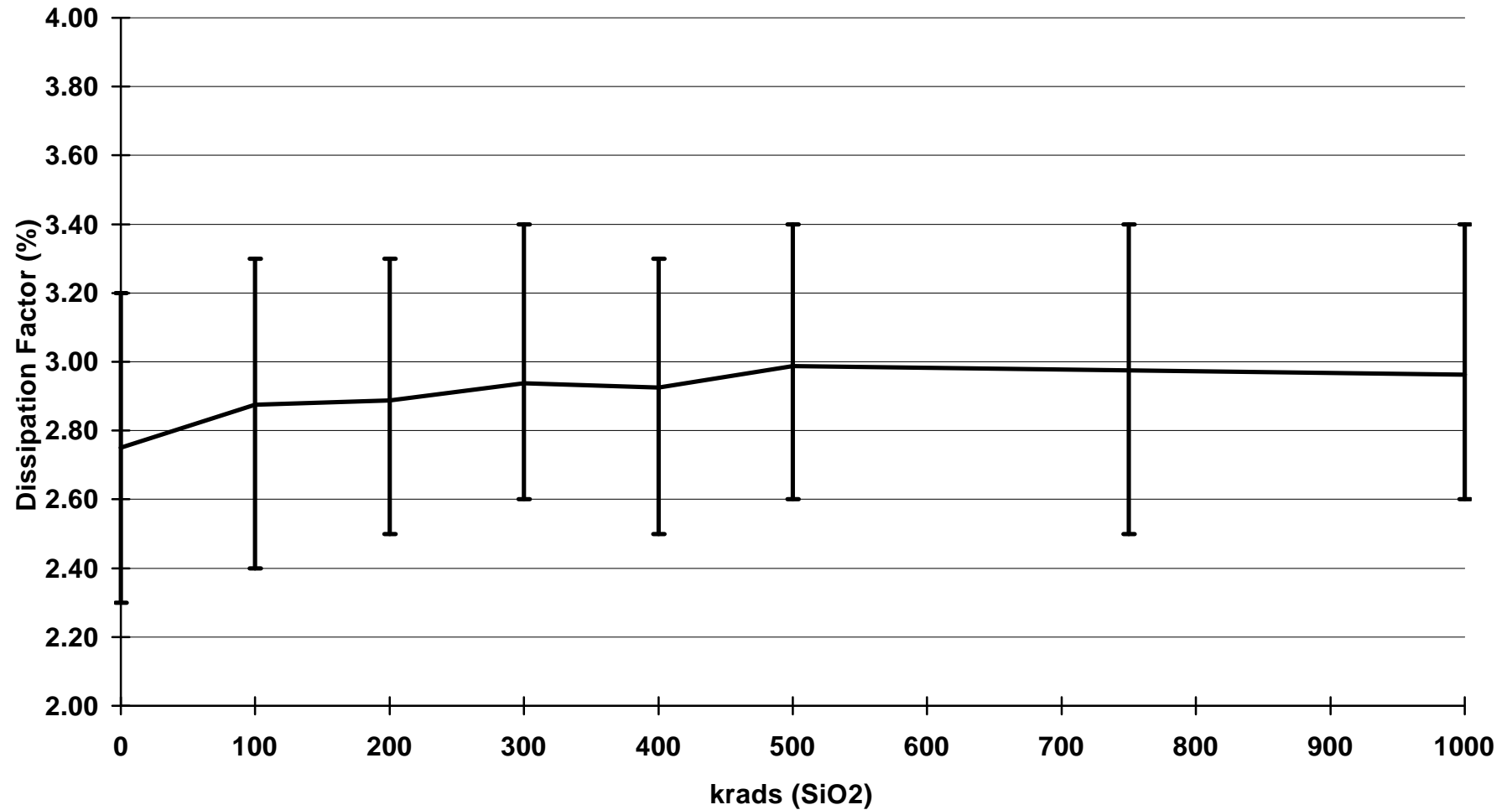
- 1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.
- 2/ These are manufacturer's non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.
- 3/ The maximum specification limit for DC leakage at 125°C is 9000 nA.

**Radiation-sensitive parameters: None**

**Figure 1. CLR79 Wet Tantalum Capacitor  
Capacitance vs. Total Dose Radiation Exposure**

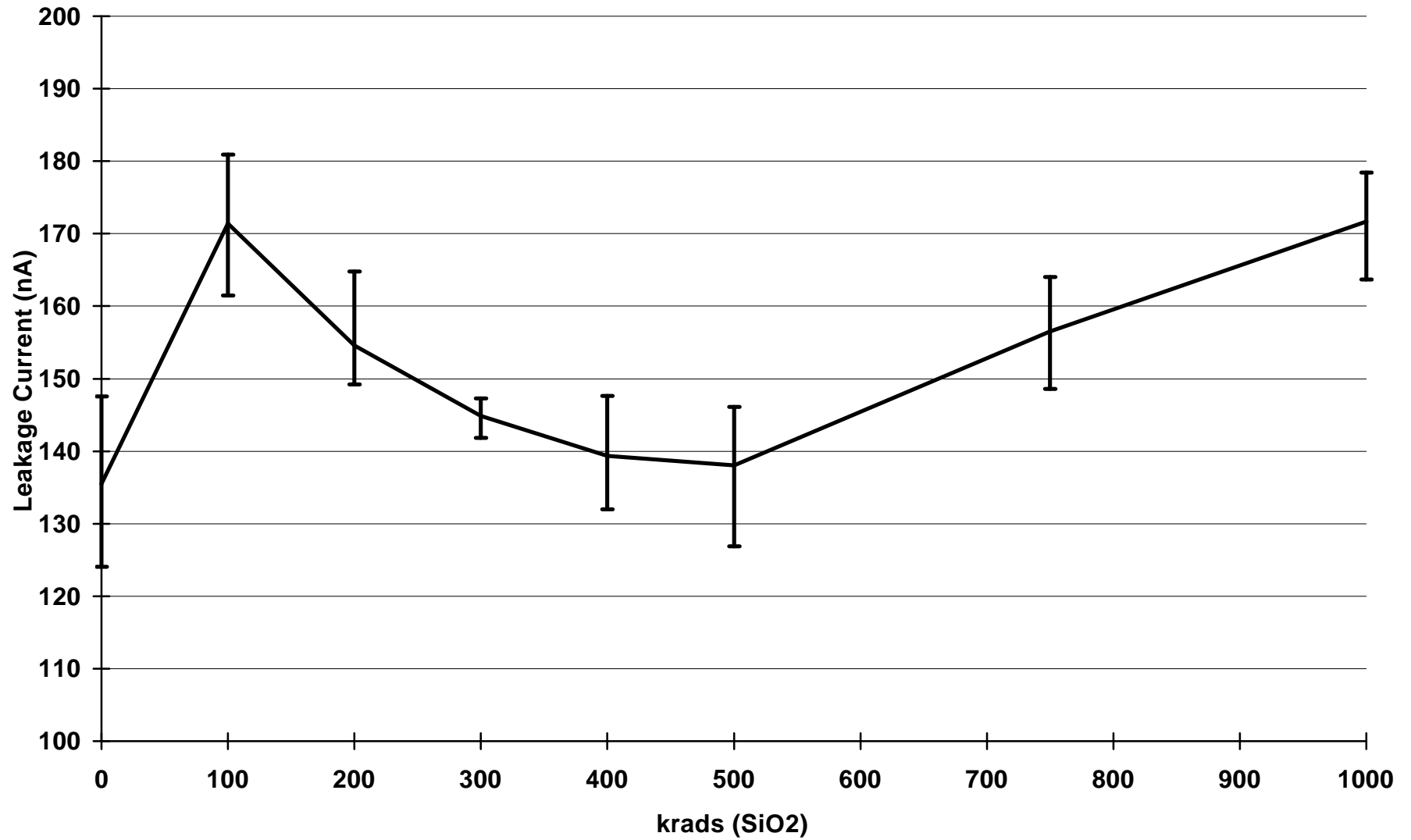


**Figure 2. CLR79 Wet Tantalum Capacitor  
Dissipation Factor vs. Total Dose Radiation Exposure**





**Figure 3. CLR79 Wet Tantalum Capacitor  
DC Leakage Current (25°C) vs. Total Dose Radiation Exposure**



**Figure 4. CLR79 Wet Tantalum Capacitor  
DC Leakage Current (125°C) vs. Total Dose Radiation Exposure**

